CHEMICAL CONTROL OF *CACTOBLASTIS CACTORUM* (LEPIDOPTERA: PYRALIDAE)

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ABSTRACT

Chemical control of *Cactoblastis cactorum* is hampered by the lack of data to support usage of many available pesticides. The application of pesticides to infested cacti is severely limited by the fact that these infested plants occur on sites in urban habitats, on public lands or in areas that are difficult to access. The use of such materials is governed by the United States Environmental Protection Agency and pesticide usage patterns, including allowable sites, must be specified on the pesticide label. There are an array of materials that could potentially be used to manage this insect with minimal impact on the environment and non-target organisms. However, there is very little research being conducted to determine the efficacy and safety of these pesticides.

Key Words: *Opuntia*, chemical control

RESUMEN

El control químico de *Cactoblastis cactorum* se ve afectado por la falta de información sobre el uso adecuado de varios pesticidas contra esta especie. La aplicación de pesticidas a las plantas de cactus que se encuentran infestadas es difícil debido a que estas plantas se encuentran localizadas en jardines urbanos, en areas de uso público o en areas de acceso limitado. El uso de pesticidas esta gobernado por la Agencia Protectora del Madio Ambiente de los Estados Unidos y las normas de aplicación de pesticidas, incluyendo las areas donde se permite su uso, deben estar especificadas en la etiqueta del producto. Hoy en dia existen varios productos que podrian ser utilizados en el control de esta especie que son poco dañinos al medio ambiente y a otros organismos. Sin embargo, en estos momentos, existen pocos estudios que proveen datos sobre la eficacia y seguridad de estos pesticidas para el control de *Cactoblastis cactorum*.

Only a few publications have addressed chemical control of the cactus moth, *Cactoblastis cactorum* (Berg) (Burger 1972; Bot et al. 1985; Pretorius et al. 1986; Pretorius & Van Ark 1992). However, no insecticide studies have been published that relate to management of *Cactoblastis* since the insect became established in Florida. This paper reviews the relevant literature, offers suggestions for candidate insecticide trials, and proposes considerations for chemical control research and management strategies.

Working in Africa, Pretorius & Van Ark (1992) evaluated stem injections of mevinphos, dimethoate, and monocrotophos. They concluded that stem injection of these insecticides was unpromising. However, they achieved good protection against larval attack with cover sprays of the same insecticides. A cover spray of cypermethin gave complete protection against larval attack. A cover spray of cypermethrin mixed with chlorpyrifos was very effective against cactus moth and *Dactylopius opuntiae* (Cockerell). Chlorpyrifos alone was also effective against both insects. Carbaryl gave poor to excellent control. Since several of the insecticides used in their work are not registered in the U.S., and continued registration of chlorpyrifos is questionable, it is time to revisit the use of insecticides in the management of cactus moth, especially considering the development of new insecticide chemistries since the previously described work. We believe that the relatively new insecticides abamectin, emamectin benzoate, imidacloprid, spinosad, indoxacarb, and chlorfenapyr, and some older insecticides such as acephate, fenoxycarb, dimethoate, and methidathion, have the potential to manage this insect in the U.S. (Table 1). Several of these insecticides are especially effective on many lepidopterous species and some possess characteristics that make them attractive for specialty uses such as control of cactus moth.

At first consideration, the very idea of utilizing insecticides to protect endangered species of plants from an introduced insect species would be questionable considering the older chemistries of the insecticides that have been examined. These materials can cause phototoxicity and are known to be very harsh to non-target organisms. However, with the new chemistries that are now available, the idea should be revisited. Several of the new chemistries are better suited for integrating with natural control and classical biological control. Abamectin, emamectin benzoate, spinosad, and indoxacarb are considered somewhat envi-

TABLE 1. SUGGESTED INSECTICIDES FOR SCREENING AGAINST *CACTOBLASTIS CACTORUM*, AS BASED ON CURRENT LABELING AGAINST TARGET LEPIDOPTERA THAT BORE INTO PLANT TISSUE.

Insecticide	Crops on which registered	Insecticide class	Characteristics of interest	Environment and safety concerns
Emamectin benzoate	Vegetables	Avermectin	Translaminar; easy on beneficials	Low
Abamectin	Ornamentals	Avermectin	Translaminar; easy on beneficials; Homoptera activity	Low
Spinosad	Ornamentals, fruit, vegetables	Spynosyn	Easy on beneficials	Very low
Indoxacarb	Vegetables	—	Easy on beneficials	Very low
Fenoxycarb	Ornamentals	Carbamate; insect growth regulator	Homoptera activity	Low
Imidacloprid	Ornamentals, fruit, vegetables	Chloro-nicotinyl	Systemic; Homoptera activity	Very low
Acephate	Ornamentals, fruit, vegetables	Organophosphate	Systemic; cacti on label; Homoptera activity	Low
Dimethoate	Ornamentals	Organophosphate	Systemic; Homoptera activity	Medium
Methidathion	Ornamentals	Organophosphate	Homoptera activity	Medium

ronmentally friendly. The potential environmental impacts associated with chlorfenapyr, especially effects on birds, might impact its approval for use in environmentally sensitive situations in the U.S. However, chlorfenapyr should be looked at since it appears to have numerous registrations outside the U.S.

To date, it appears that none of the new insecticides have been examined for the control of cactus moth. Therefore, for this discussion, it might be useful to speculate on the potential of insecticides for cactus moth based on insects that have aspects of their biology that are similar to cactus moth. The focus of chemical control should be the prevention of the first instar from boring into the stem (cladode). Thus, insecticides used against insects that bore into plant tissue after egg hatch would be considered potential candidates for evaluation against cactus moth. Insecticides were considered with the following insects on the label: diamondback moth; azalea, citrus, and other leafminers; Nantucket pine tip moth; codling moth; and artichoke plume moth (Table 1). Also some of these insecticides are effective on Homoptera, offering potential protection against cochineal insects, *Dactylopius* spp. Several of these insecticides are systemic, thus offering potential protection against cactus moth larvae that have successfully invaded a cladode.

Pyrethroids could be considered for managing cactus moth in the U.S., however, their use would be considered problematic in that they are harsh on beneficial insects and the high level of contact toxiticity could present problems for non-target Lepidoptera, such as threatened or endangered species that may be occurring within the same habitat. We suggest that the ideal insecticide would be one that, when applied, quickly enters the surface of the cladode and remains there for an extended period of time, but rapidly breaks down on the stem surface, presenting minimal problems to parasites and predators. Of the new chemistries, abamectin, emamectin benzoate, and indoxacarb are absorbed into leaf tissue, and should be examined for management of cactus moth. Even though abamectin is not effective against many caterpillars, it has shown unusual activity against some species, such as the diamondback moth, *Plutella xylostella* (L.). In addition, abamectin is registered for use on ornamental plants indoors and outdoors, making it readily available for use.

Focusing the management program on preventing the entrance of first instars into the cladodes requires knowledge of the pattern of oviposition of the cactus moth. Knowing the seasonal nature of oviposition as well as whether oviposition occurs over short, well defined periods, or occurs over protracted periods without well defined peaks is very important in planning insecticide application strategies. Apparently there are two or more well defined generations in Australia and South Africa (Pettey 1948; Robertson 1985). However, more generations might be expected in warmer climates. In Florida Johnson & Stiling (1998) have shown that the cactus moth appears to have a protracted oviposition period, with oviposition increasing in the spring and fall. Johnson & Stiling (1998) indicated that new larval damage varied over time and location, which is to be

expected considering the subtropical to tropical nature of Florida's climate. Therefore, a monitoring program would be very useful to precisely time insecticide applications, thereby reducing the amount of insecticide needed in the management program.

Protocols for evaluating the insecticides need to be devised in such a way to account for the natural behavior of the first instar. This is necessary for any insect, however, with the cactus moth, the habit of the neonate larvae collectively burrowing and entering a cladode through a single entry hole (Hoffmann & Zimmermann 1989) makes it necessary to place great attention to this behavior. It is speculated that this behavior overcomes the gum-secretions encountered by the neonates while burrowing into the cladode (Hoffmann & Zimmermann 1989). Similarly, the caterpillars that are first to colonize might succumb to the insecticide, but allow successful entry of the following larvae. Therefore, bioassays that don't allow this behavior to occur could provide misleading results. The effects of this behavior on insecticide efficacy need to be investigated.

In conclusion, as with many insects in a natural setting, the biology of the cactus moth probably precludes the use of insecticides in the management of this insect in the wild, and research should be conducted to evaluate the potential of classical biological control. However, in culturally managed plantings of cacti which can be monitored and which are amenable to application equipment and techniques associated with small and large-scale monoculture, several insecticides of different chemical groups might be used successfully, along with biological control, to manage the cactus moth. With the development of new insecticides that are increasingly amenable to usage in ecologically and politically sensitive environments, it would be worthwhile to revisit the use of insecticides for the control of cactus moth.

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